

# THE FROG

DEPARTMENT OF BIOLOGY  
UNIVERSITY OF TORONTO

QL  
668  
E2  
U58  
c.4

# THE FROG

DEPARTMENT OF BIOLOGY  
UNIVERSITY OF TORONTO

~~Private Property~~  
Memorial  
Library

## INTRODUCTION

The scheme outlined in the following pages gives a number of approaches in Biological method. It is difficult to classify them in order of importance, and they are listed below with the more mechanical first.

- A—The acquirement of skill in dissection and the display thereby of parts in an animal.
- B—The record of observations rendered possible by dissection.
- C—The solution of an animal as a working whole into the recognized constituent parts of the whole.
- D—The recognition of the part played by adaptation to physical and functional environment in a specific animal.
- E—The variations that are shown in the local fauna allied to the type.

---

## THE FROG (*Rana pipiens*)

### *External Anatomy*

The frog is bilaterally symmetrical about a median axis. It is a Chordate, since in the embryo a longitudinal notochord forms the axis of the body. It is also a Vertebrate, since in the adult the notochord is replaced by a segmented vertebral column.

#### *Identify:*

- Head, trunk, limbs. Is there a neck? What is the significance of this question?
- Mouth, eyes, eyelids.
- Nictitating membrane—a thin, translucent membrane which may be stretched over the eye from the lower side.
- External nares (nostrils). Note the anterior margin which is moved to close the opening.
- Brow spot or frontal organ in the median line between or a little in front of the eyes. This is a vestige of the pineal or median eye and in mammals the organ is entirely enclosed in the skull.
- Tympanic membrane or ear drum behind the eye.
- Sacral hump in the back of the frog. Examine the skeleton of a frog and explain the presence of this hump.

Anus or vent—the posterior opening of the alimentary tract.

Upper arm, fore arm, wrist, hand.

Thigh, shank, ankle, foot.

Note normal position and direction of segments in each limb.

Why are they not the same in anterior and posterior limbs?

Note the number and relationship of fingers and toes. Are there any nails or claws?

On the male frog there is a swelling at the base of the inner digit on the anterior limb. Is your specimen a male or a female?

Examine the skin of the frog. Note the folds where the skin is attached to the body. Look for scales or hairs.

The colour is due to pigment in the skin. Note the general distribution of the black pigment as well as the character and arrangement of the spots.

In what ways is a frog suited to its normal surroundings?

Draw dorsal view and answer on a separate sheet all the questions asked above.

#### *Mouth Cavity*

Open the mouth by cutting the muscles in the angles of the jaw.

##### *Identify:*

1. Projections due to the eyes. How does the frog close the eye?  
The same mechanism aids in swallowing.
2. Internal nares; probe them.
3. Maxillary teeth on upper jaw and vomerine teeth on roof of mouth. Determine the extent and distribution of the teeth. Are there teeth on the lower jaw? Why?
4. Tongue and its attachment.
5. Pharynx—the narrowed posterior region of the mouth.
6. Glottis—a longitudinal slit in the middle of an elliptical elevation formed by the two arytaenoid cartilages. It leads to the larynx and lungs.
7. Eustachian tube—a tube leading from the tympanic cavity. Cut away the tympanic membrane from its supporting annulus (a cartilaginous ring), noting a small bone (columella) which is attached to the tympanic membrane and which extends to the internal ear. Pass a probe through the tympanic cavity and Eustachian tube into the mouth cavity.

8. Oesophagus—leading from the mouth to the stomach.
9. In the male only, two small openings below the angles of the jaws open into the vocal sacs.

Make a drawing illustrating the above mentioned structures with the mouth wide open.

### *Muscles of Ventral Body Wall*

Make a median longitudinal cut through the skin only on the ventral surface of the frog from a point just in front of the anus to the tip of the lower jaw. Note the attachments of the skin to the underlying muscles and the fluid (lymph) which fills the subcutaneous lymph spaces.

Make transverse cuts through the skin, laterally along the fore legs, and just where the hind legs join the body. Turn back the flaps of skin and pin them down, exposing clearly the muscles of the ventral body wall.

*Identify and draw:*

1. The sternum—a bony and cartilaginous structure lying in the mid-ventral line between the fore arms.
2. The xiphoid cartilage is the posterior extremity of the sternum.
3. The rectus abdominis—2 strap-shaped muscle, one on either side of the mid-ventral line extending from the sternum in front, to the pubis behind.
4. The linea alba separates the right and left recti.
5. These muscles are divided into segments by five transverse connective tissue septa, the inscriptions tendinae.
6. The pectoralis major—a large fan-shaped muscle on either side of the anterior part of the body. It is composed of three parts, an abdominal portion arising from the sides of the rectus abdominis muscle, a middle portion arising from the sternum and an anterior portion arising from the mid-line anteriorly. All three portions converge toward their attachment to the fore leg.

Carefully dissect the abdominal portion of the pectoralis major from its attachment along the rectus abdominis and turn it back, exposing the sheets of muscle lying under it.

7. The obliquus externus—a large muscle, mostly under the

abdominal portion of the pectoralis major. covers most of the sides of the body. Its fibres extend obliquely downwards and backwards.

Very lightly scrape away a few of the obliquus externus fibres, thereby exposing the fibres of the underlying muscle.

8. The obliquus internus and transversus combined, lies under the obliquus externus and has fibres which run transversely or downwards and forwards.

9. The submaxillary muscle which extends transversely across the floor of the buccal cavity between the two rami of the lower jaw. It raises the floor of the buccal cavity in respiration.

### *Digestive System*

Make a longitudinal cut through the body wall *a little to the left side of the median line* from the origin of the hind legs to the shoulder girdle (a bony structure which can be felt between the fore legs). Keep the points of the scissors well up so as not to injure the underlying organs.

Lift the body wall carefully and note the abdominal vein attached to the wall. Separate it from the wall, then make transverse cuts through the wall and pin back the flaps, exposing the viscera (internal organs).

Note—If the specimen is a female and the ovaries enlarged with eggs so that they fill the body cavity, remove *one ovary only* from the *left side* of the specimen by cutting through its attachment to the dorsal abdominal wall, leaving the right side for the study of the urinogenital system.

*Identify without tearing or cutting any part:*

1. The peritoneum—a smooth membrane which lines the whole coelome or body cavity, covers the viscera, and holds them in position. Note that the digestive tube is swung by this tissue from the middle of the back of the frog. By what route do the blood vessels and nerves from the body wall travel to the digestive tube? This tube is in reality swung in a fold of the peritoneum.

The peritoneum, although a continuous sheet, is known as

- (a) parietal peritoneum—where it covers the body wall,
- (b) visceral peritoneum—where it covers the viscera,

- (c) mesentery—where it connects an organ to the body wall,  
(d) omentum—where it connects two organs.
2. The liver. How many lobes are there? The liver drains into the alimentary canal through the bile duct.
  3. The gall-bladder—a thin-walled sac partly embedded in the liver. This serves to store some of the bile produced in the liver and has only one opening, that into the bile duct.
  4. The oesophagus—a short tube from the mouth cavity to the stomach. Pass a probe from the mouth into the stomach, through the oesophagus.
  5. The stomach—lying beneath the liver. The large anterior end is the cardiac portion, the posterior end the pyloric portion. Note the constriction at the pylorus. A valve at this point controls the passage of food from the stomach to the intestines. Acid digestion occurs in the stomach and alkaline digestion in the intestines.
  6. The pancreas—an irregular gland surrounding the bile duct in the membrane between the stomach and intestine.
  7. The intestine—consists of three portions:
    - (a) duodenum—that portion extending from the pylorus parallel to the stomach and receiving the bile duct;
    - (b) ileum—the much coiled portion;
    - (c) rectum—the enlargement at the posterior end for the temporary storage of indigestible material while water is reabsorbed from it.
  8. The mesenteries:
    - (a) the mesogaster—supporting the stomach;
    - (b) the intestinal mesentery—supporting the intestines;
    - (c) the mesorectum—supporting the rectum.
  9. The omenta:
    - (a) hepato-duodenal omentum—peritoneum connecting liver and duodenum;
    - (b) gastro-duodenal omentum—peritoneum connecting stomach and duodenum;
    - (c) gastro-hepatic omentum—peritoneum connecting stomach and liver.
  10. The spleen—a round, dark-coloured gland in the intestinal mesentery. The spleen is not connected with the digestive system, but is a ductless gland associated with the blood system. Determine the function of the spleen.



Make a drawing of the digestive system so far studied. Show the various structures spread out so that they can be clearly represented and labelled in correct relationship.

*Construct diagrams:*

- (a) a cross-section through the body of the frog to illustrate the relationship of coelome, peritoneum and alimentary canal. Label with the terms in (1) above.
- (b) a sagittal section to show the succession of mesenteries in (8) above.

### *Venous System*

The blood which flows to all parts of the body in arteries passes into minute vessels, capillaries which join eventually to form veins. Thus the blood system is described as a closed system.

Expose the heart by cutting through the shoulder girdle to the left side of the median line.

The blood from the posterior part of the body returns to the heart through several systems of veins.

1. The abdominal vein formed posteriorly by the union of the two pelvic veins from the hind limbs. Follow it anteriorly and locate its entrance into the liver where it breaks up into capillaries.
2. The renal portal vein may be seen on the lateral margin of the kidney. Cut the peritoneum and tip up the outer edge of the kidney. Trace the renal portal back to the two veins that unite to form it. The sciatic lies dorsally and comes from the posterior part of the leg. It may be exposed by removing the skin from the hind leg and cutting across the long bone of the hip girdle (the ilium), on the left side only. The femoral is more ventral and comes from the lateral or anterior part of the leg. The femoral vein gives, as a branch, the pelvic vein (1). The blood stream entering the kidney by the renal portal breaks up in capillaries within the kidney.
3. The postcaval vein. The capillaries in the kidney containing blood from the renal portal and from the renal arteries reunite to form a number of small renal veins, which, from right and left, join to form the postcaval. Trace this vessel forward. It receives body wall veins and spermatic veins and passes through the liver. Then it receives the hepatic veins and enters a thin-walled dorsal chamber of the heart, called the sinus venosus.

Open the pericardium, a thin membrane covering the heart, and locate the postcava between liver and heart.

4. The hepatic portal vein carries blood from the stomach, intestine, spleen and pancreas and runs parallel with the bile duct to the liver, where it breaks up into a system of capillaries. The blood is recollected in the two hepatic veins which enter the postcaval immediately in front of the liver. These may be covered by the anterior part of the liver.

The blood from the anterior portion of the body enters the sinus venosus by a pair of precaval veins. Each precava is formed by the union of the following vessels:

1. External jugular—anterior and ventral, bringing blood from the tongue and floor of the mouth.
2. Innominate—formed by the union of two veins:
  - (a) the internal jugular from the brain and various parts of the head;
  - (b) the subscapular from the outer side of the fore limb and shoulder.
3. Subclavian—formed by the union of two vessels:
  - (a) the brachial from the fore limb;
  - (b) the musculo-cutaneous from the body wall.

Make a drawing of a ventral view of all the above mentioned veins and the sinus venosus.

#### *Arterial System and the Heart*

The heart lies within the pericardial sac, which encloses a pericardial cavity separated from the coelomic cavity. The pericardial sac consists of two layers (continuous with one another at the base of the heart), the parietal (or pericardium), forming the outer layer of the sac, and the visceral (or epicardium), covering the surface of the heart.

The heart consists of the following chambers:

- (1) sinus venosus;
- (2) two thin-walled atria;
- (3) a thick-walled muscular ventricle.

From the ventricle is given off a short but rather large tube, the conus arteriosus. This divides into a truncus arteriosus on each side, and each truncus divides to form 3 vessels:

1. The common carotid—carrying blood to the head region, divides into two vessels: (A) the internal carotid which passes laterad and dorsad and has on it an oval enlargement

called the carotid gland, which contains a spongy network serving as an impediment to the blood flow and equalizing the distribution; (B) the external carotid which passes directly forward.

2. The aortic arch—which passes dorsad and gives off laterally the subclavian artery to the anterior appendage. Posteriorly the two aortic arches unite to form the large dorsal aorta from which branches are given off to supply all the posterior parts of the body
  3. The pulmo-cutaneous which divides into two vessels—the pulmonary going to the lung and the cutaneous to the skin. What part corresponds to the innominate artery in the mammal? The chief vessels given off from the dorsal aorta are:
    1. Coeliaco-mesenteric. This divides into two branches, the coeliac and the superior mesenteric.
      - (a) The coeliac divides into 2 main vessels—the gastric to the stomach, and the hepatic to the liver.
      - (b) The superior mesenteric supplies the intestine, spleen, and a portion of the rectum.
    2. Urinogenital arteries—four to six pairs supplying the reproductive organs and kidneys.
    3. Lumbar arteries—several pairs arising from the dorsal side of the aorta, and supplying the body wall.
    4. Inferior mesenteric—a small artery supplying the posterior portion of the rectum.
    5. Right and left iliac arteries—formed by the branching of the dorsal aorta to supply the posterior appendages.
- Draw a ventral view of the heart and arteries.

### *Respiratory System*

The respiratory system consists of three parts:

- (a) The mechanism for breathing:

External nares and valves.

Internal nares.

Mouth—especially the floor of the mouth, which acts as an inspiratory air pump. Expiration is brought about by the elasticity of the lungs and the contraction of the abdominal muscles.

Glottis—opening from the pharynx toward the lung.

Compare the method of breathing in the frog and the mammal.

(b) The mechanism for sound production:

Larynx—a chamber into which the glottis opens.

Cut around the glottis with scissors, remove the respiratory organs and slit open the larynx and a lung.

(Frogs are very commonly infested by lung and bladder flukes.)

Note in the larynx—a pair of broad plastic bands (the vocal cords) across the air way. These are supported by the arytaenoid cartilages and their tension and hence vibration rate is varied by the muscles attached to the cartilages. The vocal sacs in the male act as resonators to give the characteristic sound.

(c) The mechanism for oxygenation of the blood:

The bronchi—very short tubes—lead from the larynx to each lung.

In the lung observe the arrangement and character of the ridges on the inner wall and their relationship to the blood vessels.

Note—in the frog the skin is also a main respiratory organ.

Make a drawing of the interior of the larynx and lung.

Construct a diagram of a sagittal section through the head and respiratory organs of a frog to show the passage of air from the external nostrils into the lungs.

*Urinary System (male and female)*

1. Kidneys—a pair of oval, dark red bodies, flattened against the dorsal abdominal wall and covered by peritoneum.
2. Adrenal gland—an irregular whitish or yellowish body on the ventral surface of the kidney. It is a ductless or endocrine gland and is connected physiologically with the circulatory system and influences blood pressure.
3. Ureter—a slender, white duct arising along the posterolateral margin of the kidney and passing posteriorly to enter the cloaca.
4. Urinary bladder (or allantois)—a thin-walled sac lying ventral to the rectum and opening posteriorly into the cloaca.
5. Cloaca—that portion of the tube from the posterior end of the rectum to the anus. It is a chamber into which the urino-genital products and the indigestible material from the digestive tract enter before being expelled through the anus.

6. Fat bodies—yellowish finger-like processes attached to the anterior end of the gonad in front of the kidney. They serve as a storehouse of nutriment. These are not connected physiologically with the urinogenital system, but with the circulatory system.

#### *Male Genital System*

1. Testes (male gonad)—a pair of ovoid whitish organs. These produce the male sex cells—the spermatozoa.
2. Vasa efferentia—a number of very slender tubes passing from the testis to the kidney through the mesorchium or mesentery of the testes. The spermatozoa pass through ducts in the kidney into the ureter.
3. Seminal vesicle—an enlargement at the posterior end of the ureter. It serves to store spermatozoa.

Note—In leopard and green frogs the male shows the persistence of a non-functional oviduct (a coiled tube) on the lateral side of the kidney.

#### *Female Genital System*

1. Ovaries (female gonad)—a pair of more or less lobulated sacs of variable size and containing ova.
2. Oviduct—a convoluted tube extending the length of the body cavity on either side of the middle line. Anteriorly near the oesophagus, each oviduct opens by a wide mouth (ostium) into the body cavity. Locate the ostia. The lower portion of the oviduct forms an ovisac (compare with uterus), which opens into the cloaca and it may be greatly distended by eggs.

Insert a probe through the anus into the rectum. Then with a scalpel divide the pelvic girdle and expose the tube in which the probe is lying.

Make a drawing of a ventral view of the urinogenital system and those organs and structures closely associated with it in both sexes.

Make a diagram of a lateral view to illustrate the relationships of the cloaca and its openings.

Compare the cloaca and anus in the frog with the urinogenital openings and anus of the mammal.

#### *Nervous System*

The nervous system is made up of the following divisions:

- (a) the central nervous system, composed of the brain and the spinal cord;

- (b) the peripheral nervous system, composed of the cranial, spinal and sympathetic nerves.

### *The spinal and sympathetic nerves*

#### *Identify:*

1. Spinal nerves—white trunks which issue from the vertebral column. There are ten pairs of spinal nerves in the frog.
2. Calcareous bodies—small masses of calcium carbonate covering the exits of the nerves from the vertebral column.
3. Brachial plexus—formed by the union of the large second nerve with branches of the smaller first and third nerves, supplies nerves to the arm.
4. Sciatic plexus—formed by connection and branches of the 7th, 8th and 9th nerves. This plexus supplies the femoral and sciatic nerves to the leg.
5. Tenth nerve—a slender nerve emerging from the side of the urostyle and uniting with a branch from the 9th.
6. Sympathetic trunks—a pair of fine longitudinal nerves lying in the abdominal cavity on either side of the vertebral column. In the anterior region they follow the aortic arches closely. Note the communicating branch of each spinal nerve with the trunk.
7. Sympathetic ganglia—small enlargements along the trunks. Each is a collection of nerve cells. Note the relation of the ganglia to the spinal nerves. Nerves from the sympathetic ganglia pass to the various viscera along the blood vessels. The largest of these is the splanchnic nerve which follows closely the coeliaco-mesenteric artery and supplies the intestine and other viscera.

Make a drawing to show the vertebral column, the spinal nerves with their general distribution, including the plexuses, and the sympathetic system. The latter may be represented in ink or with coloured pencil if desired.

### *Dorsal Surface of the Brain*

Remove the skin from the dorsal surface of the body and over the top of the head. Do not injure the eyes. Remove the muscle dorsal to the vertebral column. Insert the points of the scissors in the external nares and cut the bone between them. Then with scissors and dissecting forceps slowly and carefully remove the fronto-parietal bones covering the brain. Always lift up on the

points of the scissors and dissecting forceps to avoid injuring the brain. After the brain is exposed remove the neural arches of the vertebrae with the scissors and thus expose the spinal cord. Do not remove either brain or spinal cord as yet.

*Identify the following structures from the dorsal view:*

1. Olfactory nerves—short stout nerves from the olfactory organs to the anterior end of the brain.
2. Olfactory lobes—the undivided anterior end of the brain to which the olfactory nerves proceed.
3. Cerebral hemispheres—ov. enlargements immediately posterior to the olfactory lobes.
4. Diencephalon—a depressed portion of the brain behind the cerebral hemispheres. A vascular membrane, the anterior choroid plexus, covers the depression and is immediately above the cavity of the brain called the third ventricle. From the posterior margin of the third ventricle a delicate stalk, the pineal body, runs forward over the choroid plexus to the brow spot.
5. Optic lobes—almost spherical enlargements behind the diencephalon.
6. Cerebellum—the transverse bar of nervous tissue immediately posterior to the optic lobes.
7. Posterior choroid plexus—a thick membrane covering the fourth ventricle of the brain posterior to the cerebellum. Turn this off to one side.
8. Medulla oblongata—that portion posterior to the cerebellum, the cavity of which is the fourth ventricle.

### *Spinal Cord*

Note the shape. Explain the variation in size. The small tapering posterior portion is called the filum terminale. The tip can be withdrawn from the urostyle. Note the groove on the dorsal surface—the dorsal fissure.

Draw dorsal view of brain and spinal cord.

### *Spinal Nerves and Ventral Surface of Brain*

#### *Origin of Nerves*

On each dorsal root occurs a ganglion just before the two roots join. After joining there are given off three nerves, a dorsal ramus,

a ventral ramus and a branch to the sympathetic trunk, the ramus communicans.

Locate the attachments of one or more spinal nerves to the spinal cord. These are called the roots—dorsal and ventral respectively.

Note the attachments of several cranial nerves to the lateral side of the medulla. Do these show dorsal and ventral roots? Locate on one side the optic nerve passing to the underside of the brain from the eye.

### *Ventral Surface of the Brain*

*Remove the brain and spinal cord from the body. On the ventral surface of the brain identify:*

1. Olfactory lobes.
2. Cerebral hemispheres.
3. Optic nerves.
4. Optic chiasma—formed by the crossing of the optic nerves on their way to their terminations in the optic lobes.
5. Infundibulum—a somewhat bi-lobed swelling immediately behind the optic chiasma. Note the roots of the third cranial nerve at its sides.
6. Pituitary body—a small rounded structure immediately posterior to the infundibulum. This is a ductless gland associated anatomically with the brain.
7. Medulla oblongata.

Make a drawing of a ventral view of the brain.

*With a sharp scalpel make a horizontal (coronal) section through the brain and identify the following cavities and passages:*

1. Lateral ventricles (ventricles 1 and 2) in the cerebral hemispheres.
2. Third ventricle—in the diencephalon.
3. Foramina of Monro—openings from the 3rd ventricle into the lateral ventricles.
4. Optic ventricles—in the optic lobes.
5. Fourth ventricle—in the medulla.
6. Ister—the passage between the 3rd and 4th ventricles.
7. Central canal—the cavity in the spinal cord.

Make a diagram to show these cavities.

### *Skeletal System*

The system may be divided into two portions:



- (a) the axial skeleton—the vertebrae, ribs and skull.
- (b) the appendicular skeleton—the supports of the limbs and the girdles which connect these to the vertebral column.

The skull is at first a cartilaginous case, the chondrocranium. As the tadpole changes to the adult frog, this is strengthened by bones of two types:

- (a) cartilage bones—formed by the replacement of the cartilage itself by bone;
- (b) derm bones—which are formed in a membrane outside of the cartilage, but closely applied to it.

In a few regions no bone is developed and the cartilage remains. The exoccipital, sphenethmoid, pro-optic and mento-meckelian are undoubted cartilage bones.

*Identify the following bones from the dorsal view:*

1. Exoccipitals—at the posterior end of the skull surrounding a large opening, the foramen magnum, and each bearing ventrally a rounded articular prominence, the occipital condyle.
2. Fronto-parietals—two bones forming the roof of the cranium, extending anteriorly from the exoccipitals to the anterior margin of the orbits (the spaces in which the eyes lie).
3. Sphenethmoid—a small portion of this bone sometimes shows anterior to the fronto-parietals. It may be seen extending laterally and ventrally.
4. Nasals—triangular bones anterior to the sphenethmoid covering the nasal capsule.
5. Pro-optics—lateral to the posterior portion of the fronto-parietal and forming the wall and roof of each otic (ear) capsule.
6. Squamosal—a T-shaped bone extending from each pro-otic to the angle of the jaw.

The upper jaw is composed of three pairs of bones:

1. Premaxillary—anterior to the nasal bone and forming the tip of the jaw, bearing teeth.
2. Maxillary—the main bone of the upper jaw, bearing teeth also.
3. Quadratojugal—a slender bone forming the posterior portion of the upper jaw.

Draw a dorsal view of the skull showing all the above bones.

*From the ventral view identify:*

1. Parasphenoid—anterior to the exoccipitals, overlapping the pro-otics laterally and the sphenethmoid anteriorly.
2. Pterygoid—a three-rayed bone lateral to the parasphenoid. With what bones does it articulate?
3. Sphenethmoid—anterior to the parasphenoid.
4. Palatine—a rod-shaped bone extending from the sphenethmoid to the maxillary.
5. Vomers—each bears a group of vomerine teeth.

Draw a ventral view of the skull showing the above mentioned bones.

The lower jaw is composed of a pair of curved bars of cartilage, Meckel's cartilages, which are incompletely covered by two pairs of derm bones.

1. Angulo-splénial—extending anteriorly from the angle of the jaw on the medial and ventral surface.
2. Dentary—overlapping the angulo-splénial and extending anteriorly.

The extreme anterior portion of the cartilage has become ossified, forming:

3. Mento-meckelian—a small bone at the tip of the jaw.

Draw a view of the lower jaw to show the three bones.

### *Pelvic Girdle, Hind Limbs and Urostyle*

Pelvic girdle—the V-shaped structure with which the hind limbs articulate. Note the articulation with the vertebral column and the cup (acetabulum) for the articulation of the hind limb. Identify the three bones which compose each half of the girdle. The union of the halves is called a symphysis.

1. Ilium—the long bone connecting anteriorly with the ninth vertebra.
2. Pubis—a triangular piece of calcified cartilage on the ventral side of the girdle forming the ventral portion of the acetabulum.
3. Ischium—the stout posterior bone forming the posterior part of the acetabulum.

Urostyle—the rod-like bone articulating with the ninth vertebra. It is composed of a number of coalesced vertebrae. Locate a small opening on each side of the urostyle for the exit of the tenth spinal nerve.

Hind limb—consisting of a powerful thigh, elongated shank and a jointed foot. The skeleton is composed of:

1. Femur—the proximal bone articulating with the pelvic girdle.
  2. Tibio-fibula—formed by the coalescence of two bones:
    - (a) the tibia—the medial or anterior bone,
    - (b) the fibula—the lateral or posterior bone.
  3. Tarsus (ankle)—composed of two long bones:
    - (a) the astragalus—articulating with the tibia,
    - (b) the calcaneum—articulating with the fibula.
  4. Metatarsals—composed of five almost parallel bones distal to the tarsal bones.
  5. Phalanges—two or more small bones distal to each metatarsal bone.
- D. is a dorsal view of the pelvic girdle, ninth vertebrae, umbilicus and hind limb.

### *The Muscles of the Thigh*

Adductor magnus—a large muscle arising from the pubis and ischium, lying on the medial part of the thigh, and inserted into the femur near its lower end. It draws the thigh towards the body.

Sartorius—a long, narrow band arising from the lower end of the ilium, lying obliquely upon the adductor magnus, and inserted into the tibia on its inner side near the end. It bends the knee.

Gracilis—a large muscle arising from the ischium, lying along the inner side of the adductor magnus, and inserted into the inner side of the head of the tibia. It bends the knee.

Semimembranosus—a stout muscle arising from the ischium, lying on the back of the thigh, and inserted into the back of the head of the tibia. It bends the knee.

Triceps extensor cru-ris—a very large muscle inserted into the front of the tibia just below the head of the latter, but arising from the pelvic girdle as three separate muscles, the rectus femoris, vastus lateralis, and vastus medialis or crureus. All these lie on the front of the thigh, and their action is to straighten the knee.

### *Muscles of the Shank*

The muscles are attached to the bones directly or by means of one or more bands of tough inelastic connective tissue called tendons. The end of a muscle which is fastened to a relatively immovable part is called the origin; the more movable end is the insertion. The

contraction of a muscle results in drawing the insertion towards the origin; the relaxation allows opposing muscles to return it to the original position.

The kinds of movements a limb may make is dependent upon the nature of its joints, and the number and attachments of its muscles. The following terms are used to indicate two of the movements produced:

(a) extensor—a muscle which by its contraction straightens out the leg, foot, etc.

(b) flexor—producing a bend.

Remove the skin from the hind leg. Carefully remove the thin connective tissue over the muscles of the shank. In identifying the following muscles do no cutting, but simply separate the muscles with a dissecting probe. After locating the attachments of each muscle, determine origin, insertion and actions.

On the dorsal surface make out the following muscles:

1. The large gastrocnemius—it has three attachments proximally. Locate each attachment. This muscle ends distally in the tendon of Achilles. Trace out its attachment.

2. Peroneus—lateral to the gastrocnemius.

Make a drawing of the bones of the leg and these two muscles with their origins and insertions.

On the ventral side of the leg identify the following:

1. Posterior tibial—attached all along the dorso-medial side of the bone.

2. Anterior tibial—on the lateral side of the tibio-fibula and lying close to the peroneus. It forks distally.

3. Extensor cruris—on the lateral side of the upper half of the tibio-fibula.

4. Tibialis brevis—on the lateral side of the lower half of the tibio-fibula.

Make a drawing of the bones of the leg and the muscles with their origins and insertions.

Make a table for these six muscles, giving name of muscle, origin, insertion, and actions.

### *Pectoral Girdle and Fore Limbs*

The pectoral girdle is a bony arch which gives support to the fore limbs. It is composed of the following parts:

1. Suprascapula—a flat, distally expanded plate, mostly composed of cartilage at the upper end.

2. The scapula—which is relatively heavy, often constricted in the middle and has on the posterior side at the lower end the
3. Glenoid fossa, which receives the head of the humerus.

From the lower end of the scapula two bars extend toward the middle line:

4. The clavicle—is the smaller anterior of these.
5. The coracoid is the stout posterior bone, constricted at the middle and broadly expanded at its inner end. Its outer end forms part of the glenoid fossa.
6. The omosternum—is a short bar extending forward from the inner ends of the clavicle and bearing on its anterior end a semi-circular expansion, the episternum.
7. The sternum—extends posteriorly from the inner ends of the coracoids, and ends in a rounded notched cartilage plate, the xiphoid cartilage.

Fore limbs:

1. The humerus—is the upper bone of the fore limb which articulates with the glenoid cavity.
2. The radio-ulna—which is the fusion of two originally distinct bones, the radius and the ulna, forms the skeleton of the forearm.

The ulnar part is produced backwards at its upper end to form the olecranon which fits over the rounded end of the humerus at the elbow joint.

3. The carpus or wrist—consists of six bones in two rows. In the proximal row the ulnare and radiale are at the ends of the ulna and radius respectively.
4. The five metacarpals—lie beyond the wrist. The first metacarpal is rudimentary and usually cartilaginous in the female, but in the male it is larger and usually becomes calcified or ossified. The other metacarpals are elongated, cylindrical bones somewhat expanded at the two ends.
5. The metacarpals—except the first, are succeeded by the phalanges, of which each of the two outer digits have three, while the two inner ones have but two.

## IDENTIFICATION OF THE FROGS AND TOADS OF ONTARIO

### Reference Books:

1. *The Frog Book*, M. C. Dickerson (University Library, Reference Library).
2. *Field Book of Ponds and Streams*, A. H. Morgan, (Departmental Library).

The amphibians of Ontario are divided into two orders:

- (a) Caudata (Urodela) or tailed amphibians (salamanders, newts, mud puppy).
- (b) Salientia (Anura) or tailless amphibians (toads, tree frogs, frogs).

Toads are distinguished from frogs by the presence in the former of the parotid gland behind the ear. From this gland an irritating substance may be secreted, which acts as a protective device.

Tree frogs are characterized by discs (in some species scarcely discernible) on the tips of the fingers and toes.

### Key to the Families of Salientia of Ontario:

- A. Parotids (glandular bodies behind ear) present ..... *Bufonidae*
- AA. Parotid glands lacking.
- B. Fingers and toes more or less enlarged at tips to form adhesive disks ..... *Hylidae*
- BB. Fingers and toes without disks ..... *Ranidae*

### Key to the Species of Bufonidae of Ontario:

- A. Profile of snout sloping; belly spotted .... *Bufo americanus*  
(Common Toad)
- AA. Profile of snout abrupt; belly usually unspotted ..... *Bufo fowleri*  
(Fowler's Toad)

### Key to the Species of Hylidae of Ontario:

- A. Disks on fingers and toes of medium or large size (never so small that they are difficult to discern).
- B. Skin rough with small warts, posterior surface of femur reticulated with yellow and black, size 2 inches ..... *Hyla versicolor*

- BB. Skin smooth or nearly so, size 1 inch ..... *Hyla crucifer*  
(The Spring Peeper)
- AA. Disks on fingers and toes so small that they are scarcely discernible.
- C. Skin rough; webs very large; muzzle long and pointed; legs long ..... *Acris gryllus*
- CC. Skin smooth; webs minute, or lacking; posterior surface of femur unspotted ..... *Pseudacris feriarum*  
(The Swamp Tree Frog)

*Key to the Common Ranidae of Eastern Canada:*

- A. Lateral folds well developed.
- B. Skin with longitudinal folds between lateral folds; definitely outlined spots on back and sides; length of leg to heel equals or exceeds total length.
- C. Spots squarish; under surface of legs orange-yellow .....  
*Rana palustris*  
(The Pickerel Frog)
- CC. Spots rounded, outlined with light ..... *Rana pipiens*  
(The Common Leopard Frog)
- BB. Skin relatively smooth between lateral folds.
- D. Legs relatively short, length to heel much less than total length; no black cheek patch ..... *Rana clamitans*  
(The Green Frog)
- DD. Legs long; black cheek patch usually present.
- E. Length of leg to heel exceeds total length .... *Rana sylvatica*  
(The Eastern Wood Frog)
- EE. Length of leg to heel approximately equal to total length ....  
*Rana cantabrigensis*  
(The Northern Wood Frog)
- AA. Lateral folds not present or only slight traces of them; ear of male longer than eye; legs relatively short.
- F. Head narrow, rounded in front; size medium (2-3 inches)  
*Rana septentrionalis*  
(The Northern Frog)
- FF. Head broad and flat; size very large (7-8 inches) .....  
*Rana catesbeiana*  
(The Common Bullfrog)

